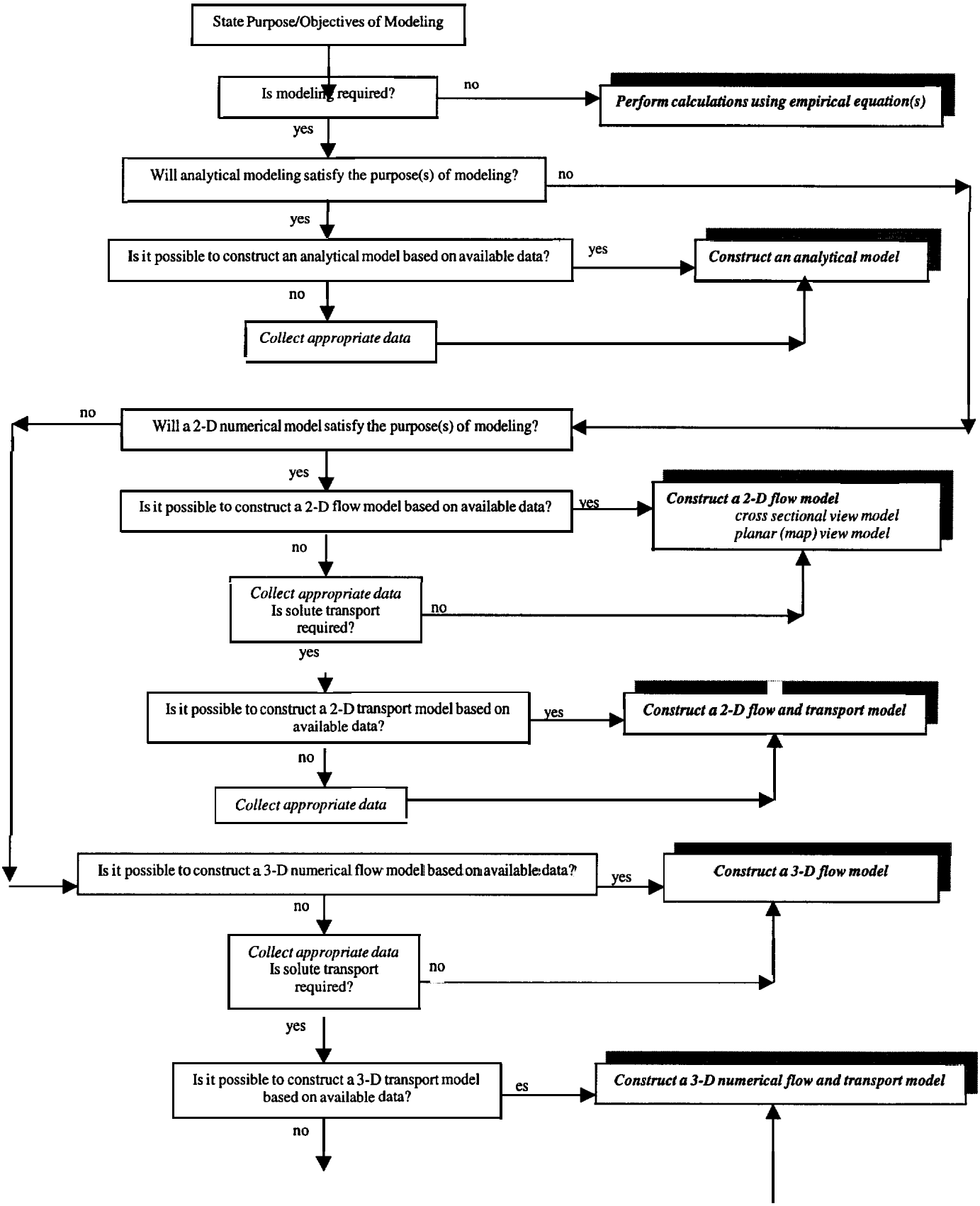
GROUNDWATER MODELING GUIDELINES

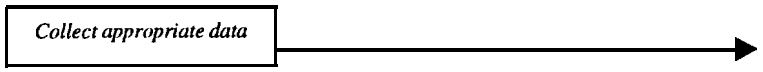
II. Determining the Level of Groundwater Modeling Required

This guideline describes the steps necessary to identify the appropriate level of groundwater modeling.

Details

Refinement and testing of conceptual models may be accomplished using mathematical models. A mathematical model is a device that represents an approximation of a field scenario. Different levels may be appropriate; ranging from solving highly simplified 1-D equations to analytical models and complex 2-D or 3-D numerical flow and transport simulations. The following simplified flowchart presents the steps to determine the appropriate level of mathematical modeling required based on project objectives:


State Purpose/Objectives of Modeling
Is modeling required?
no
Perform calculations using empirical equation(s)
yes
Will analytical modeling satisfy the purpose(s) of modeling?
no
yes
Is it possible to construct an analytical model based on available data?
yes
Construct an analytical model
no
Collect appropriate data
no
Will a 2-D numerical model satisfy the purpose(s) of modeling?
yes
Is it possible to construct a 2-D flow model based on available data?
yes
Construct a 2-D flow model
cross sectional view model
planar (map) view model
no
Collect appropriate data
Is solute transport required?
no
yes
Is it possible to construct a 2-D transport model based on available data?
yes
Construct a 2-D flow and transport model
no
Collect appropriate data
Is it possible to construct a 3-D numerical flow model based on available data?
yes
Construct a 3-D flow model
no
Collect appropriate data
Is solute transport required?
no
yes
Is it possible to construct a 3-D transport model based on available data?
es
Construct a 3-D numerical flow and transport model
no



Flow Chart Depicting the Steps for Determining the Appropriate Level of Modeling

Step 1
The first step in any modeling project is to state the purpose of the modeling study. The reason for modeling may encompass several objectives. Typical modeling objectives are:
- Enhancement of conceptual understanding of the flow system
- Identify data gaps and guide site characterization activities (including placement of monitoring wells)
- Simulate the present and predict the future concentrations of contaminant compounds in groundwater
- Compare the effectiveness of remedial alternatives
- Characterize source areas
- Estimate risk (human health or ecological) versus cost (regulatory requirement)
- Optimize remediation plans, engineering design or monitoring network
- Characterize uncertainty to support management decisions

Step 2
Once the purpose has been established, the actual characteristics of the model are considered. Examples are:
- Area(s) to be modeled
- Wells to be included in the study
- Aquifer(s) and zones of interest
- Transport concerns (particle tracking and/or concentrations, transport times)
- Steady-state or transient conditions
- Units and coordinate system to be used.

Step 3
The next step is to assemble and evaluate the data available for modeling. These data include hydraulic parameters derived from aquifer pumping tests and slug test data, water level measurements (head), chemical concentrations, etc. Evaluation of data is the subject of the previous guideline, "Evaluating Hydrogeological and Hydrochemical Data for Groundwater Modeling."

Step 4
The final step is to determine the type of model required that satisfies the project objective(s). In some cases, an approach as simple as solving a mathematical equation may be suitable for satisfying the objectives. An example is the Ogata-Banks equation, a 1-D advection-dispersion equation. In other cases, analytical or numerical modeling may be required. If the existing data do not support the modeling efforts, collection of additional data is warranted.